The Space Weather Analysis

National
Geophysical
Data
Center

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NOAA/NGDC
AFCCC Tech-Expo
Sept 16th, 2004

The Space Weather Analysis

Objective: Generate a complete space weather representation using physically consistent data-driven space weather models.

- Initially 11 year cycle
- Model driven to fill extremely data sparse region of near-Earth environment
- Couples observational data with data-driven, physics based numerical models
- An enhanced look at the space environment on consistent grids, time resolution, and coordinate systems

Result: E*asily incorporated impacts of the near-Earth space environment* in environmentally sensitive models.

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The SWR will create a uniformly distributed, integrated, record of
the near-earth (magnetopause tail-ward) STP environment.
This effort could be integrated with other interplanetary and
solar efforts to create a complete STP record.

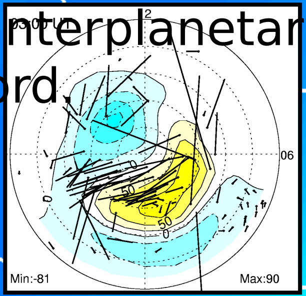
Energetic
Solar Particles

Inner Heliosphere

Solar
Magnetogram
Driven
Heliosphere

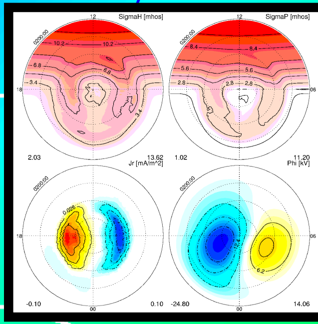
Eruptive
Event

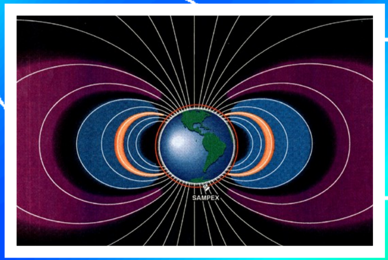
Project Boundary



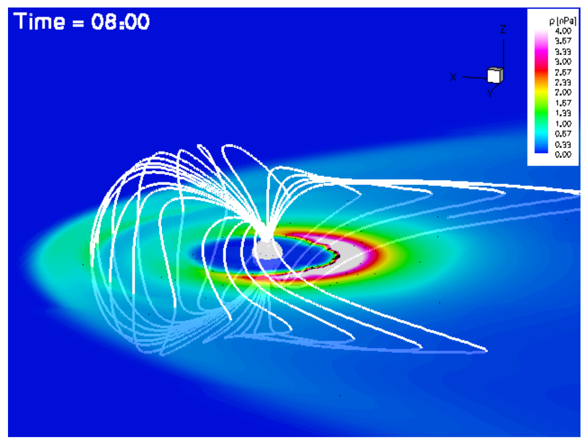
Data Assimilation

Ionospheric
Electrodynamics



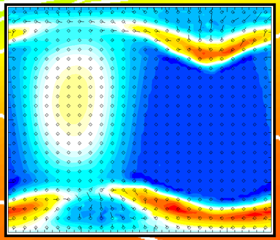


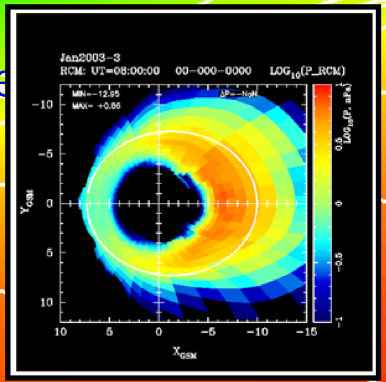
Radiation Belts



Global
Magnetosphere

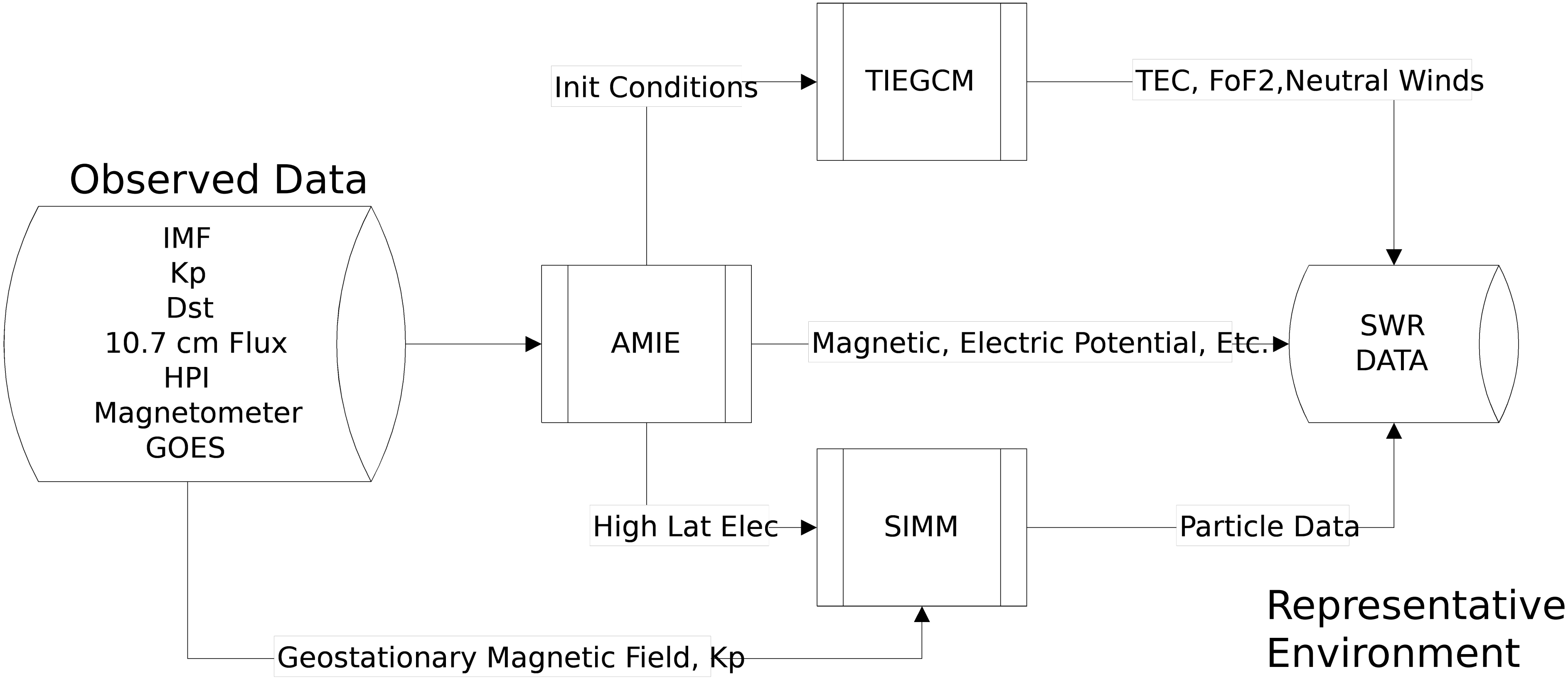
Global Ionosphere
& Thermosphere





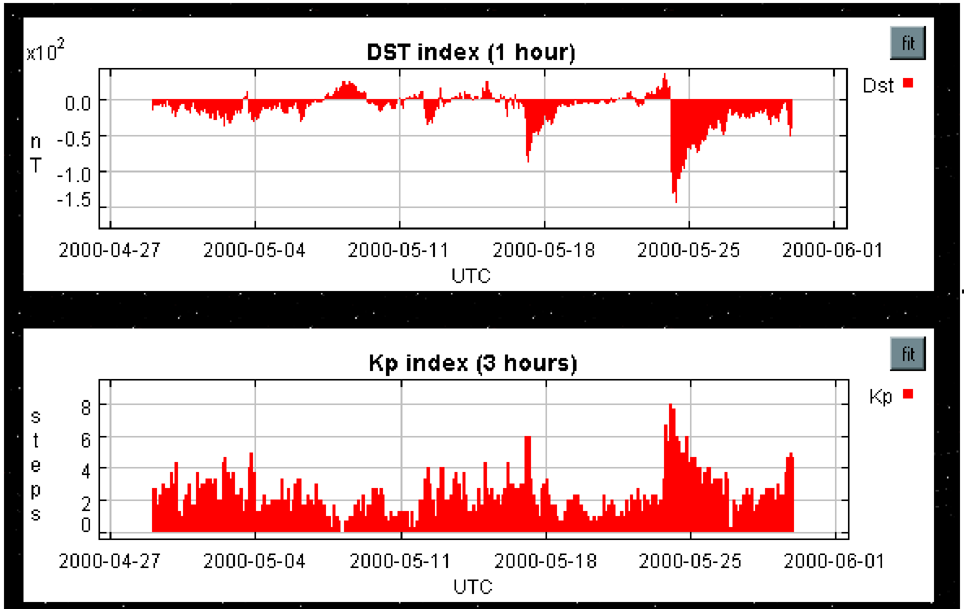
Inner Magnetosphere

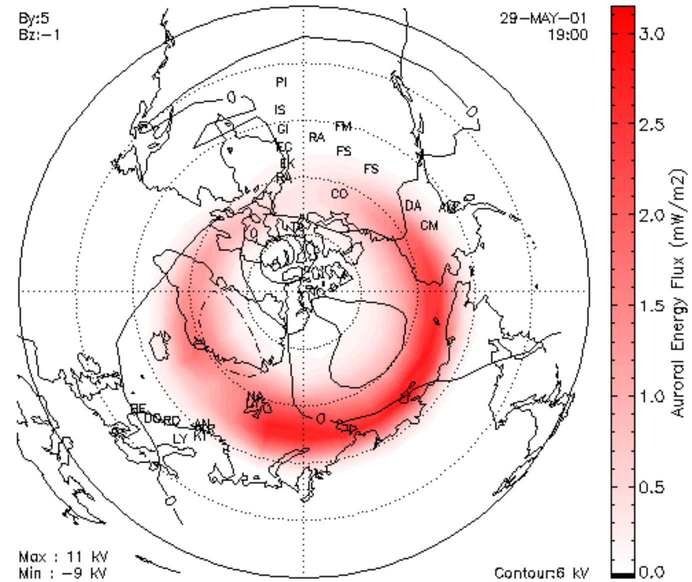
SWA Current Methodology

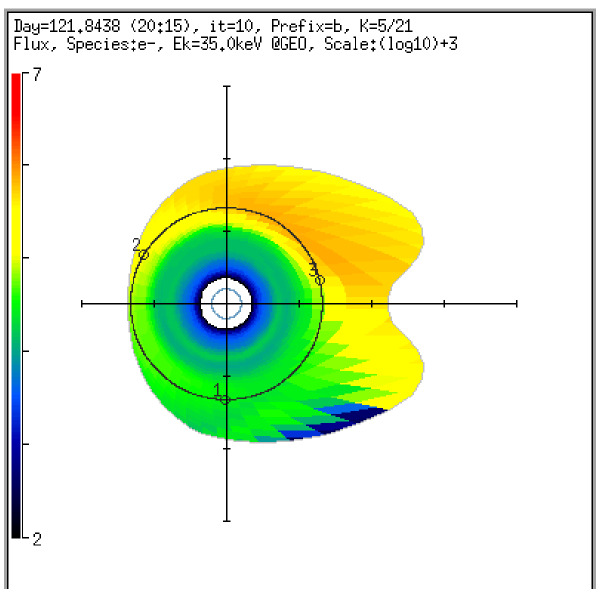


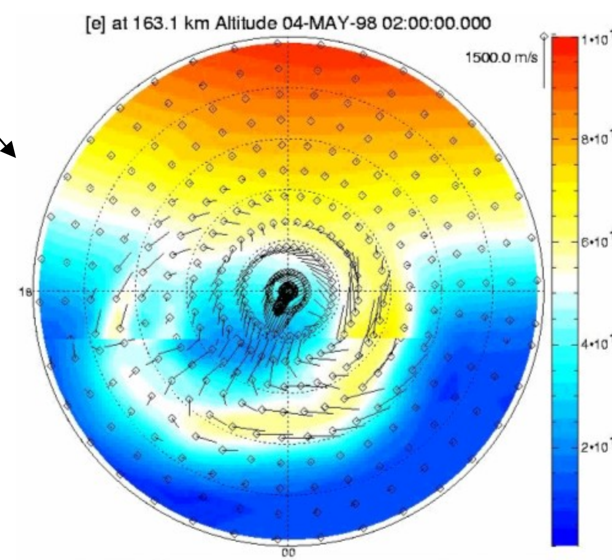
The SWA effort will both integrate and evaluate existing domain specific models to create the best representation of the environment possible. The important criteria in model selection include accuracy, ability to ingest observations and open interfaces for cross model integration. The above flow diagram represents data flow for those models currently incorporated.

Sample SWA Products









SWA Project Task Areas

- Data Preparation
  - Collection
  - Quality Control
  - Compilation
  - Presentation
- Data Assimilation
  - Data Ingest
  - Model Integration
- Data Evaluation
  - Sensitivity Studies
  - Validation
  - Comparison
  - Peer Review
- Data Distribution
  - Translation/Interpolation
  - Grids (resolution
  - Variables
  - Mechanism

Computer Resources

JET Supercomputer
FSL/NOAA

Basic Information

- **768 Intel Pentium 4 Xeon Nodes (Dual 2.2 GHz Processors)**
- **Myricom Myrinet CLOS64 (2.4 Gbs)**
- **ADIC Fileserve MSS (100 Tbytes)**
- **NGDC was the #2 JET user for 2003**
- **The SWA consumed 400,000 + CPU Hours**
- **The SWA has produced over 2.5 Tb data, this exceeds all of NGDC's non-satellite holdings!**

The SWA requires a tremendous array of computer support in order to meet its goals. Challenges include sufficient CPU power, integrating distributed model runs, and storage space for input and output data sets. The SWA project makes use of shared time on FSL's JET supercomputer as well as RAID and Tivoli based storage

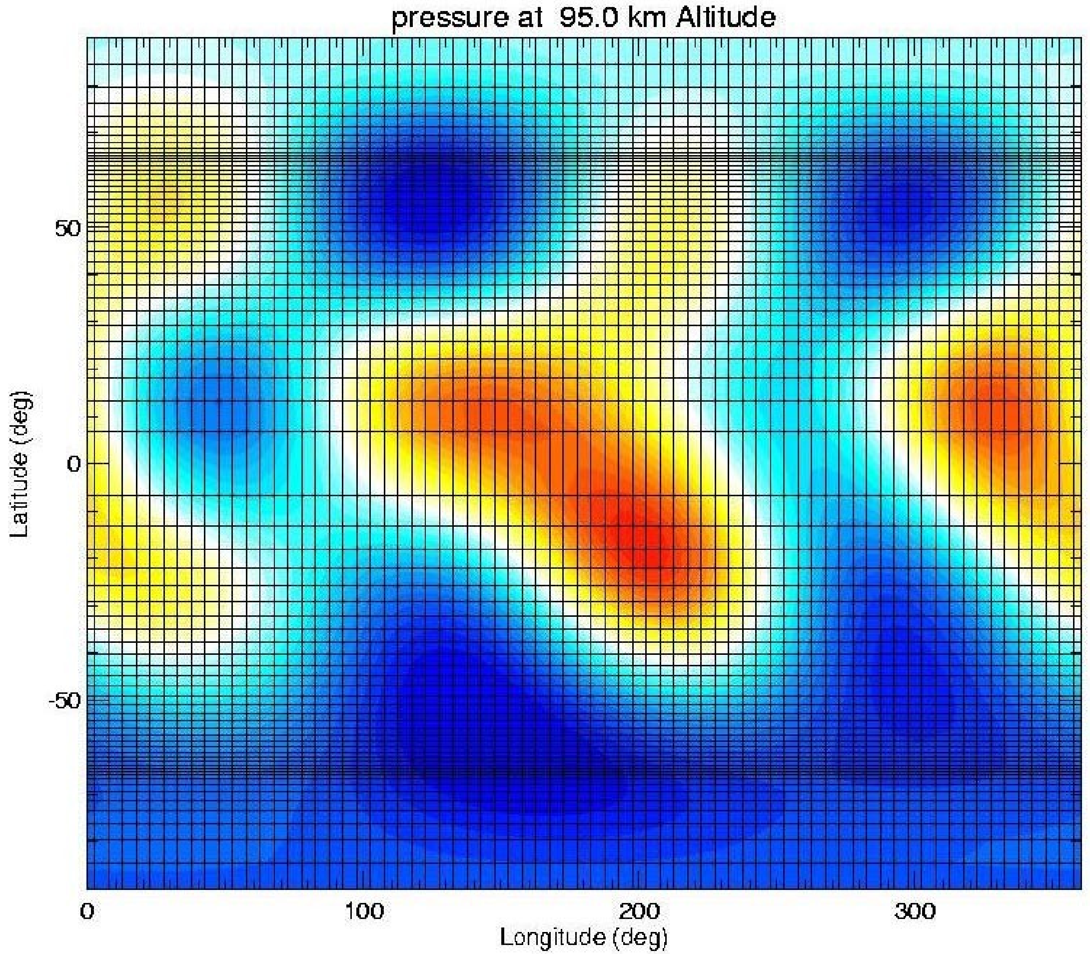
AMIE

The AMIE Technique

The assimilative mapping of ionospheric electrodynamics (AMIE) technique uses a method of data inversion to determine the high latitude (above 50) ionospheric electric field pattern *[Richmond and Kamid*e, 1988; *Richmon*d, 1992]. The data inputs include ion velocities measured by radars, satellites, and ionosondes, ground magnetic perturbations, and magnetic perturbations measured
by satellites. In addition, measurements of precipitating particles and ultraviolet images of the aurora taken from satellites are used to determine the ionospheric conductances, which are needed
to invert the ground magnetometer data.

GITM

Newly created global ionosphere thermosphere model (GITM) to model the neutral and ion composition, temperature, and dynamics from 95-750 km altitude.

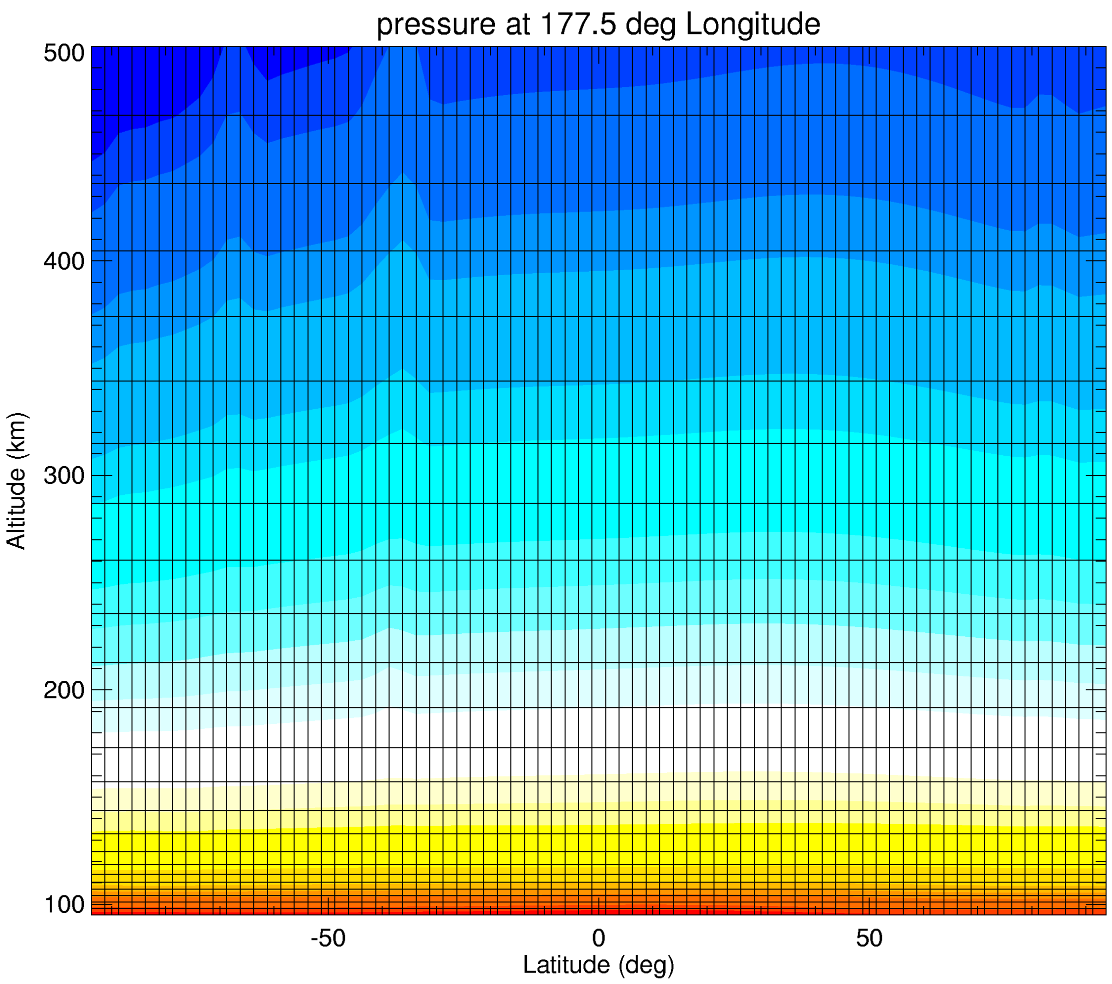


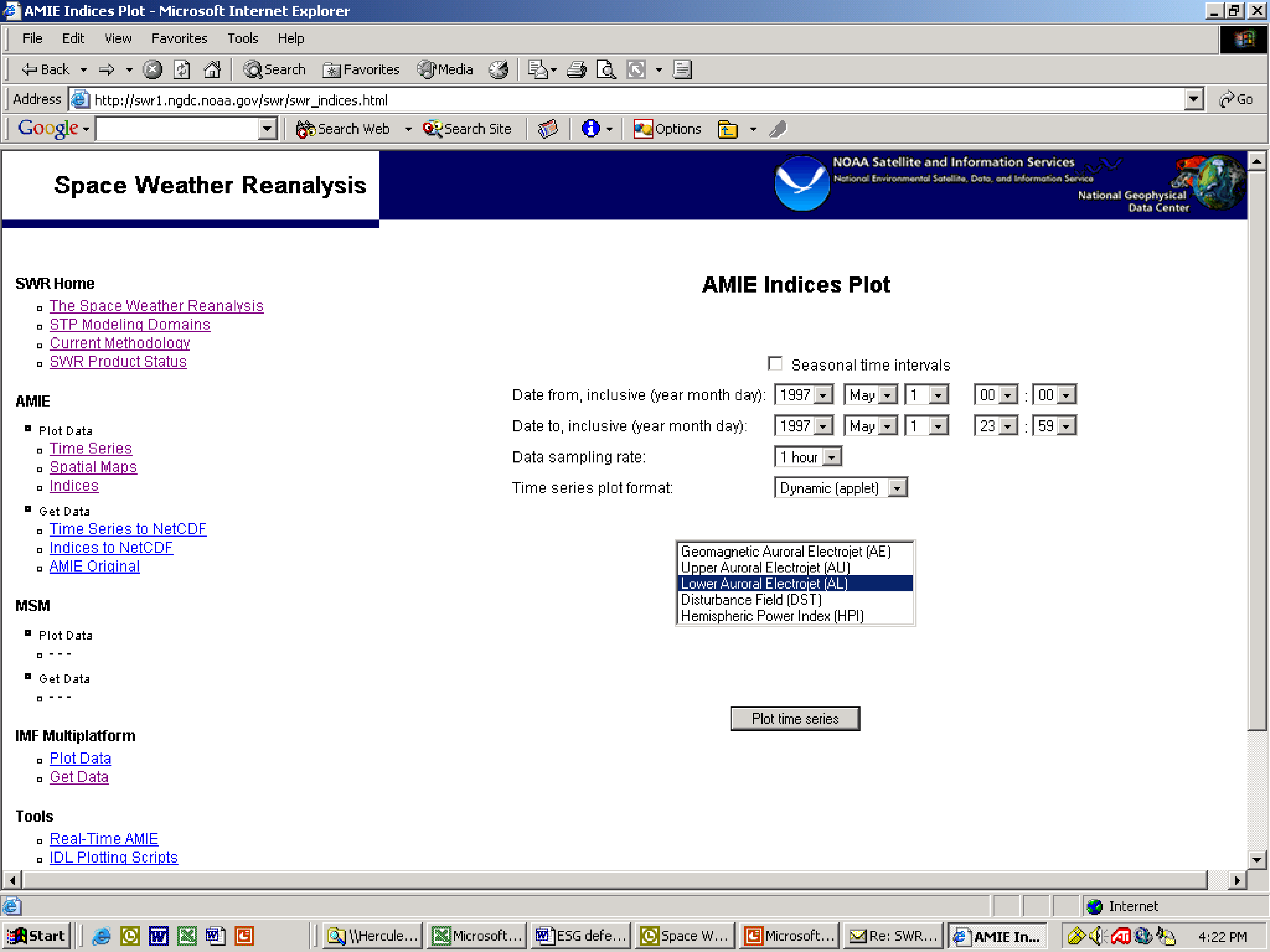
GITM is a fully parallel code which can be run on multipl

GITM Physics

GITM solves for:

- 6 Neutral Species
- 5 Ion Species
- Neutral winds
- Neutral Temperatures
- Ion and Electron Convection
- Ion and Electron Temperatures
- Solves in Altitude coordinates

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Search
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Media
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Space Weather Reanalysis
NOAA Satellite and Information Services
National Environmental Satellite, Data, and Information Service
National Geophysical Data Center
SWR Home
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AMIE
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Plot Data
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Get Data
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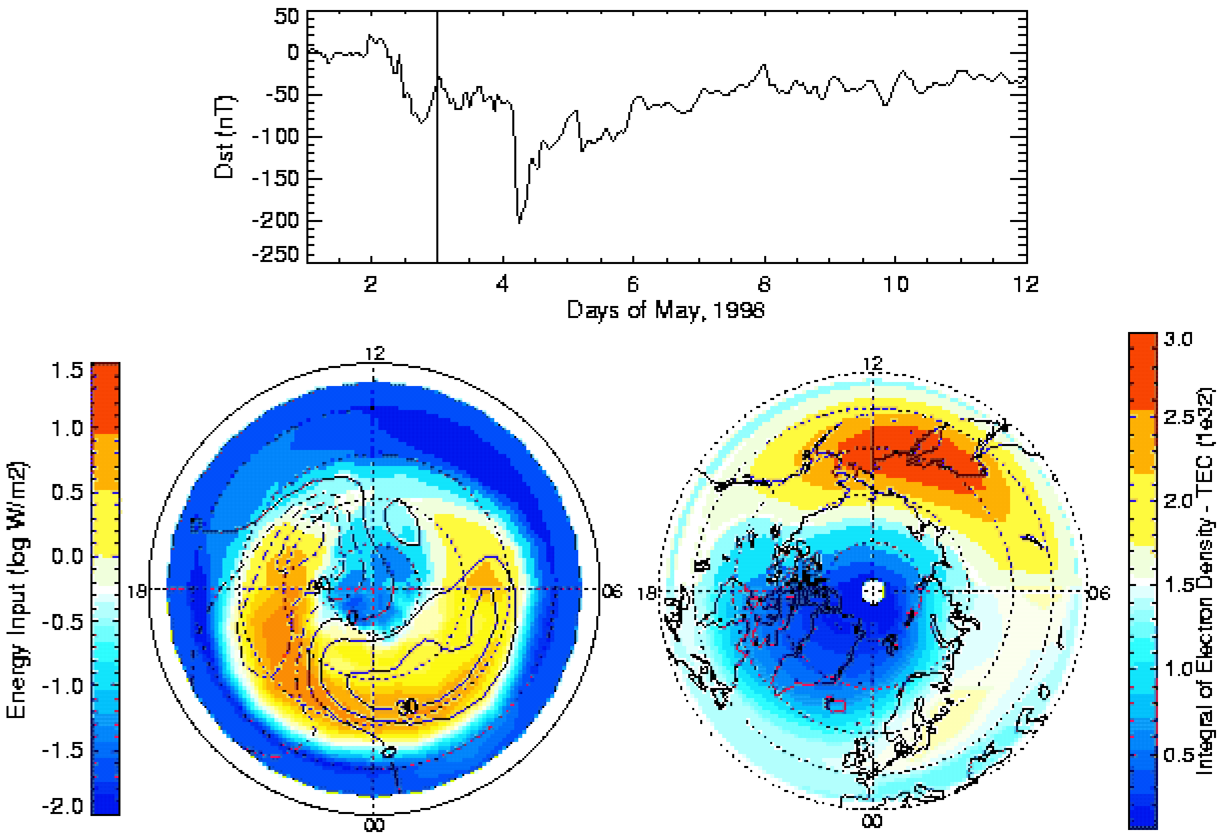
IMF Multiplatform
Plot Data
Get Data
Tools
Real-Time AMIE
IDL Plotting Scripts
AMIE Indices Plot
Seasonal time intervals
Date from, inclusive (year month day): 1997 May 1 00 : 00
Date to, inclusive (year month day): 1997 May 1 23 : 59
Data sampling rate: 1 hour
Time series plot format: Dynamic (applet)
Geomagnetic Auroral Electrojet (AE)
Upper Auroral Electrojet (AU)
Lower Auroral Electrojet (AL)
Disturbance Field (DST)
Hemispheric Power Index (HPI)
Plot time series
Internet
Start
\\Hercule...
Microsoft...
ESG defe...
Space W...
Microsoft...
Re: SWR...
AMIE In...
4:22 PM

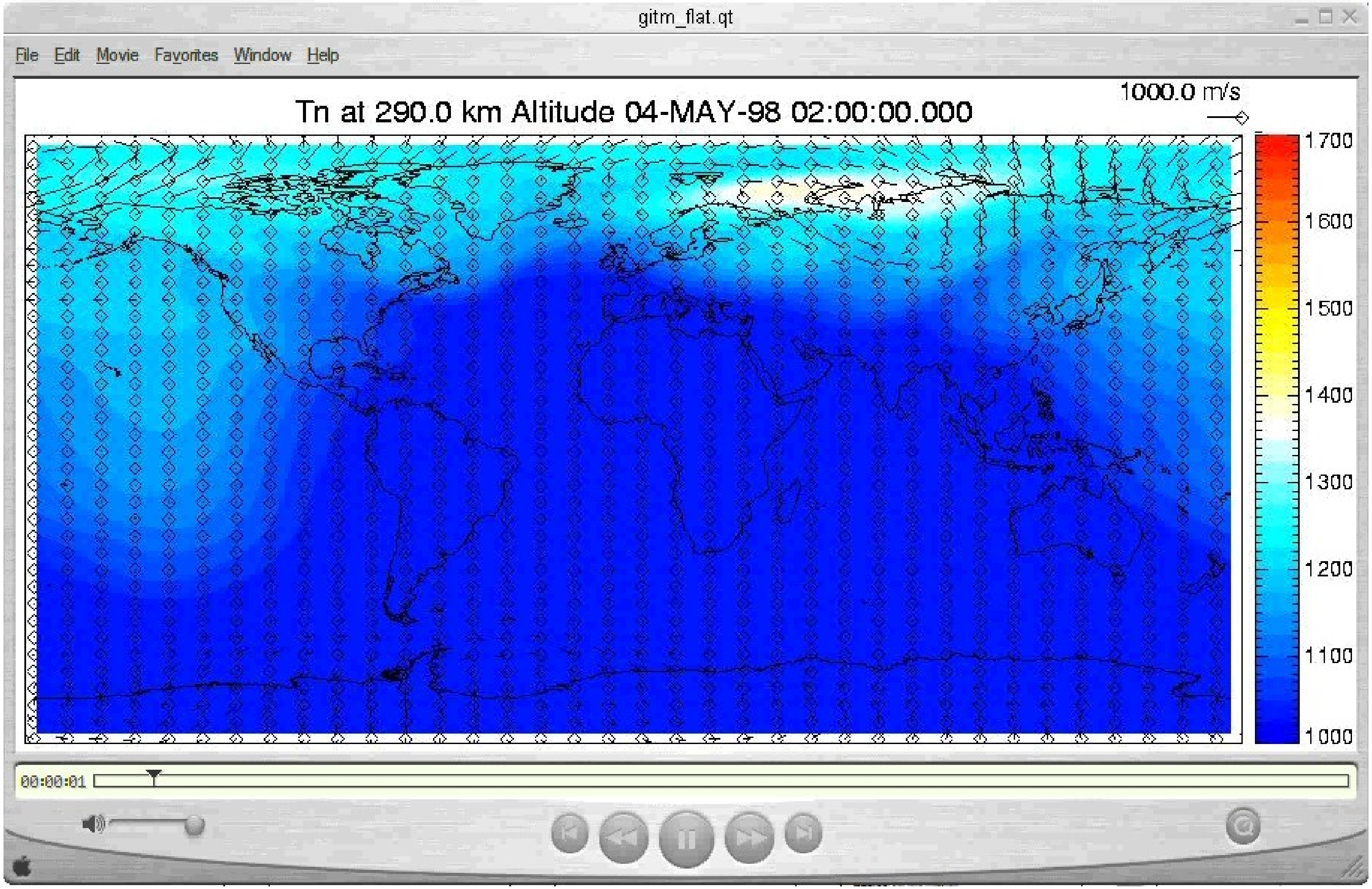
SWA Data Products :Total Electron Content



1 hr resolution for the May 1998 storm

Neutral Results

The magnetic storm causes intense heating



SWA On the shelf Products

- New HPI database (DMSP, NOAA)
- New 100 + magnetometer database.
  - 210 MM, Canopus, Tromso, Greenland, Image, etc..
- Complete IMF Record
- AMIE Runs @ 1.0 minute (1997-2001)
- GITM Runs (1997-2001)
- MSM runs (1997-1998)

SWA Current FY Products

- Integrated 1991-1996,2002 Model Runs
- AMIE runs at 1.0 minute through 1991-1996, 2002
- GITM runs for 1991-1996
- MSM runs for 1992-2002 complete
- Integration of the product with ESG
- Selection and first draft for radiation belt model

Data Partners

CANOPUS

CRL

Geophysical Institute
University of Alaska Fairbanks

IRF

IPS
Radio & Space Services

UNIVERSITETET I TROMSØ

WDC System

ACE
Real Time Solar Wind